TETRA TECH

October 31, 2014

Mr. Phil Williams, Director of Public Works
City of Edmonds
121 Fifth Avenue N
Edmonds, WA 98020

Subject: **Order-of-Magnitude Estimate of Cost to Relocate BNSF Tracks Below Grade**

The Edmonds waterfront is separated from downtown Edmonds by the Burlington Northern Santa Fe Railroad (BNSF) tracks, with two roadways connecting the city across the tracks: Main Street and Dayton Street. These streets provide the sole vehicular and pedestrian access to Edmonds' waterfront. When trains move through or make stops in Edmonds, access to the waterfront including emergency access is severed, affecting residents, businesses, the Port of Edmonds, and Washington State Ferries' terminal operations.

Gate closures at the Main and Dayton Street crossings are increasing in frequency and duration with growing train traffic. Significant ongoing growth in the number and length of trains has been forecast since 2005. These forecasts were developed in advance of the recent expansion of coal and oil shipments which will further extend gate closures beyond the durations cited above.

The extended gate closure times, and blocked vehicular and pedestrian access to the waterfront present multiple issues for the City of Edmonds and its residents:

- Denial of public safety services (police, fire, EMS) to the waterfront
- Delays in vehicle loading and unloading at Washington State Ferries' terminal
- Interruption of Community Transit bus service
- Denial of access to and from residences, commercial and industrial businesses, and services
- Denial of access to and from four City shoreline parks, the Port of Edmonds marina, the underwater dive park, the Senior Center, residences, and businesses.

In addition to the extended gate closures, other expressed concerns of Edmonds residents regarding the increased rail traffic include:

- Transport of hazardous materials through the city
- Increased risks to residents and the shoreline environment from accidents and spills
- Increased frequency of safety horns sounding, particularly at night
- Impacts of the above concerns on property values, economic development potential, and the peace and tranquility for which Edmonds is known.

The City of Edmonds is considering approaches to improve access across the BNSF tracks to waterfront businesses, residences, the Port and the ferry terminal. One proposed concept would reconstruct the railroad tracks in a depressed grade to eliminate the train-vehicle conflicts at Main Street and at Dayton Street. This concept is referred to herein as the "Train Trench" concept.

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In order to determine how the Train Trench concept should be appropriately considered with other potential approaches to address issues of reduced waterfront access, a preliminary estimate of the potential cost of such a construction project is needed. The City retained Tetra Tech, Inc. (Tetra Tech) to develop an initial approach and sequence to construct the Train Trench concept, and to prepare an order-of-magnitude estimate of the cost to plan, design, permit, and construct the project. This memorandum presents the outcomes of Tetra Tech's cost estimating efforts that included:

- Compiling existing, available data provided by the City on conditions along the project corridor encompassing: property ownerships and rights-of-way, soil conditions, City GIS data, major City utilities, railroad design/construction drawings, Willow Creek relocation, Sound Transit southbound loading platforms, and other information that may be useful to estimating the scope of constructing the Train Trench.
- Selecting and developing a single method and sequence to construct the Train Trench concept along the existing railroad alignment. The construction method was developed to a conceptual level only, illustrated by preliminary alignment/profile and selected cross sections generated from topographic data in the City's GIS. Because there are no opportunities to re-route train traffic, the method was necessarily developed so as to maintain continuous railroad service along the corridor throughout construction.
- Preparing an order-of-magnitude cost estimate, presented as a range of costs to reflect the conceptual basis of the construction planning. The cost estimate includes elements for planning, engineering and design, permitting, environmental review documentation, and construction phases. The estimate is accompanied by documentation of general assumptions appropriate to the conceptual level of design development.

This memorandum summarizes the analysis and presents the order-of-magnitude cost estimate for the City's consideration.

The Train Trench Concept

The Train Trench concept would excavate a trench along the current railroad right-of-way to install the tracks below grade to create a grade separation from the surface streets at Main and Dayton. The concept is illustrated below in rendered images posted on a website by an Edmonds resident.

Source: www.edmondstraintrench.net

The depth of the trench is driven by the required vertical clearance for the trains, specified by the BNSF's design standards, the rail bed and rails below the trains, plus the height of the roadway bridges at Dayton and Main streets. At its maximum depth, extending between Main Street and Dayton Street, this depth has been assumed to total 30 feet measured from existing grade to the interior bottom of the trench structure.

As the trench extends to the north from Main Street and to the south from Dayton Street, the trench would gradually grow shallower. The slope at which the tracks may climb is typically 1.0%, but can be increased to 1.5%(18 inches every 100 feet), under some circumstances. The transition to the maximum slope is along a vertical curve, and the maximum rate of curvature is dictated under railroad design standards as a function of the design speed of the tracks. In developing the concept design, Tetra Tech has taken an aggressive approach to the geometric design in an effort to minimize the length of the trench and, thereby, the project footprint, cost and the extent of potential grading conflicts. The resulting length of the train trench project would be 7800 feet, or approximately 1.5 miles.

The extent of the train trench is shown in a plan view of the alignment in Figure 1, and in profile in Figure 2. A series of cross sections of the trench structure at locations along the alignment is depicted in Figure 3.

The interior width of the trench must accommodate two sets of tracks plus required lateral clearances for an estimated total interior width of 36 feet. Currently there is a single track through the downtown area, and the rail bed was recently widened to accommodate two tracks in accordance with BNSF's agreements with Sound Transit to provide capacity for commuter rail service along BNSF's tracks.

Alignment Features Affecting Construction

There are a number of features that complicate the construction of this Train Trench that would need to be resolved during the design and permitting of the project, and which affect the cost of construction. This discussion is limited to features of the project that directly influence the design and means of constructing the project that substantially affect its projected cost.

Proximity to the shoreline. The north and south ends of the Train Trench would be constructed in close proximity to the shoreline. Working through the boulders that support the rail bed, containing the underlying soils, keeping the excavation free of heavy inflows of salt water from Puget Sound, and limited working area outside of the track alignment. Other sections of the train trench would be constructed along the edge of the Edmonds Marsh.

The proximity to the shoreline also expands the scope of permitting and environmental review to which the project would be subjected. Rigorous protections of these waters will be a requirement of any permitted construction.

Proximity to slopes. On the other side of the railroad alignment, portions of the trench must be constructed against steep slopes. At the south terminus of the trench, the project runs

along the slope below the Point Edwards development. Immediately north of Main Street, the constructed project must support the slope below Sunset Avenue.

Urban setting. Where the alignment is not immediately abutting shoreline or slopes, the remaining corridor is bounded by urban uses and improvements. This setting limits the space available for staging construction, determines the need for mitigation measures, and most significantly dictates a constrained footprint and that the trench must employ vertical sides, as there is no room to lay back slopes. It is anticipated that some additional right-of-way may be required to accommodate the project's construction and operation.

Shallow groundwater. The groundwater table is found at shallow depth throughout the alignment, and the deepest portions of the trench must be excavated 20 feet or more below the water table. Dewatering will be required during construction to lower the groundwater table within the excavation. The groundwater table also fluctuates due to tidal influence. The trench structure must be watertight, adding to its cost. Construction of the trench will need to address the buoyant forces exerted on the structure, so the structure must be tied down to solid soils using piling.

Soil conditions. Soils along portions of the alignment exhibit poor strength. Extensive piling depth was required to support the bridge structure recently constructed to cross over the Willow Creek relocation channel.

Grade conflicts. The interior depth of the train trench where it crosses the new bridge at Willow Creek, near the off-leash park, would be on the order of 6 feet, with the bottom of the structure extending below. The design grades for the Willow Creek (also known as Shellabarger Creek) relocation through the bridge structure conflict with the required grade for the train trench, i.e., the train trench structure would block the proposed channel. The length of the channel relocation would need to be extended further south, and a new bridge crossing would be required to route the channel under the tracks.

Active Rail Line. A major influence on the means, duration and cost of constructing the Train Trench is that the work must be performed while maintaining an active rail corridor. The rail line cannot be shut down, as there is no alternative route in Western Washington (refer to Figure 4). The proximity of the construction to an operating rail line slows and interrupts construction activity, limits options for accessing the work, and restricts the staging of the work. In general, this extends the duration of construction and the impacts to surrounding infrastructure and activities, and increases the overall cost of the project.

Comparisons to other Projects

The foregoing discussion of features along the project alignment presents distinctions from the construction of other depressed-grade railroad projects. Some projects have been cited as comparable to the Edmonds Train Trench concept. The following discusses the degree to which solutions for such projects were found to be applicable to the project in Edmonds.

Reno, NV

- No active rail line – trains were rerouted to a separate shoofly alignment to allow unimpeded construction activity along the alignment. Constructing a shoofly on a separate alignment is not feasible through downtown Edmonds; hence, a third active line must be maintained in the rail corridor, which affects both the rate of construction and railroad operations.
- Soil conditions allowed for sloping the sides of the trench or the use of soil nailing to retain steeper slopes. These methods are precluded by the saturated ground conditions existing along the Edmonds alignment.
- Constructing below water table – the Reno construction extended a few feet below the water table, requiring short cutoff walls to control the migration of water into the structure, and pumping to convey the limited water out of the structure. In Edmonds, the excavation will extend to over 20 feet below the groundwater table, requiring a much more robust means of sealing the trench from groundwater and supporting the saturated soils along the walls of the excavation.

Port of Vancouver, WA

- No active rail line – this project constructed a new rail alignment.
- Partially constructed below grade to about one-half the maximum depth of the Edmonds project, with the remaining train clearance achieved above grade
- Water levels extend to only a limited distance above the trench bottom, and the water levels are only periodically elevated to these levels during extreme flood events

Alameda, CA

- No active rail line
- Not proximate to water or shorelines

Construction Sequence

The construction the trench is based on maintaining one rail line operational at all time with flagging to maintain public and contractor safety. The trench is constructed with up to five-foot diameter secant pile wall construction methods. Construction staging is assumed to be available on-site. The drilling will be performed on a rail-mounted platform on the non-active line and the work will sequenced progressively from one end of the alignment. The wall is constructed with alternating lean concrete short piles and longer reinforced concrete structural piles. The lean concrete short piles act as lagging for the longer structural piles. There is 6 inches of overlap between the piles to increase the water resistance and seismic integrity of the wall. The construction will begin with drilling the lean concrete shafts at nine-foot centers. The structural shafts are then drilled through the lean concrete shafts. There is a concrete cap beam along the top of the piles to create structural continuity and distribute any localized loads from soil instability or seismic loads. The soil between the completed secant pile walls is excavated and the spoils removed on a rail-mounted platform in a container. A base slab is provided, supported by precast concrete beams which span between the secant pile walls. The slab is provided to resist soil heave due to water pressure. The slab will also reduce water intrusion into the trench. A concrete fascia is then provided along the walls' interior faces using light reinforcement and shotcrete. The concrete fascia provides both architectural value and increased water intrusion resistance.

Construction Schedule

The duration of construction is estimated at three years. The duration of the work directly affects the cost of the project. The limited working space also restricts the ability of a contractor to simultaneously install the secant piles at multiple locations.

Estimated Costs

A cost estimate is provided in an attachment to this memorandum. The attachment provides the construction cost basis for the major elements of the work and for anticipated construction to restore affected infrastructure and surrounding improvements.

In addition, the Estimate Summary presents other costs associated with the project's construction:

- **Design Contingency**. Until the design of the project is complete, there are myriad unknown conditions which cannot be specifically accounted for in the construction cost estimate. At a planning level of project development, a 30% design contingency is commonly applied; however, since no design has been initiated for this project, little is known about the conditions that may be encountered, and the owner of the railroad has not been consulted on the design provisions for the Train Trench concept, a design contingency of 50% is warranted.
- **Management Reserve**. A management reserve is applied to the estimate to allow for potential change orders that can arise during the construction of the project.
- **Project Management & Administration**. These are cost incurred by the City to manage the construction contract and coordinate between the contractor, stakeholders, permitting agencies, and the railroad owner.
- **Engineering**. The anticipated cost of developing the design of the project, geotechnical investigations, engineering, preparation of construction documents, and bidding the construction contract.
- **Environmental Mitigation**. The project will necessarily protect the area and receiving environments from impacts of the construction and operation of the project. These costs would be determined through the course of environmental review and permitting for the project. In addition to the amount identified for environmental mitigation, a line item has been included in the base construction cost estimate to modify and extend the current design for the relocation of Willow Creek.
- **Environmental Review and Permitting**. The project scope and configuration would be more fully defined through the environmental review process, with the development and evaluation of alternatives for their respective impacts and the necessary mitigation. Project commitments and obligations would be further detailed in the permit conditions for constructing the project.

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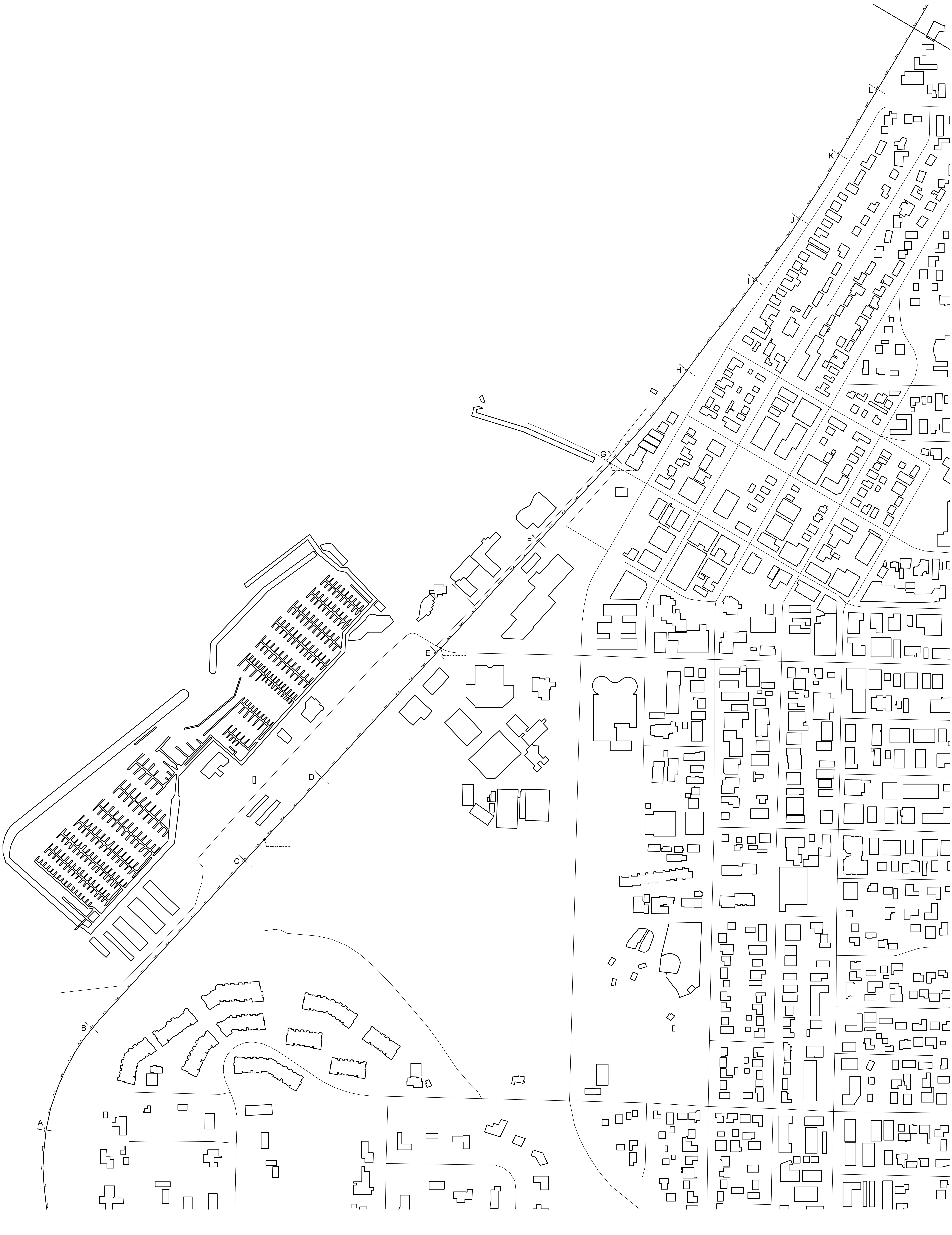
FIGURES



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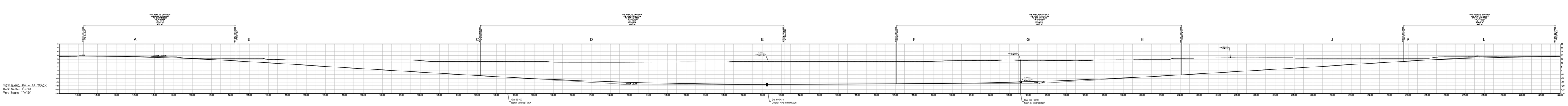

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Vert Scale: 1"=10'

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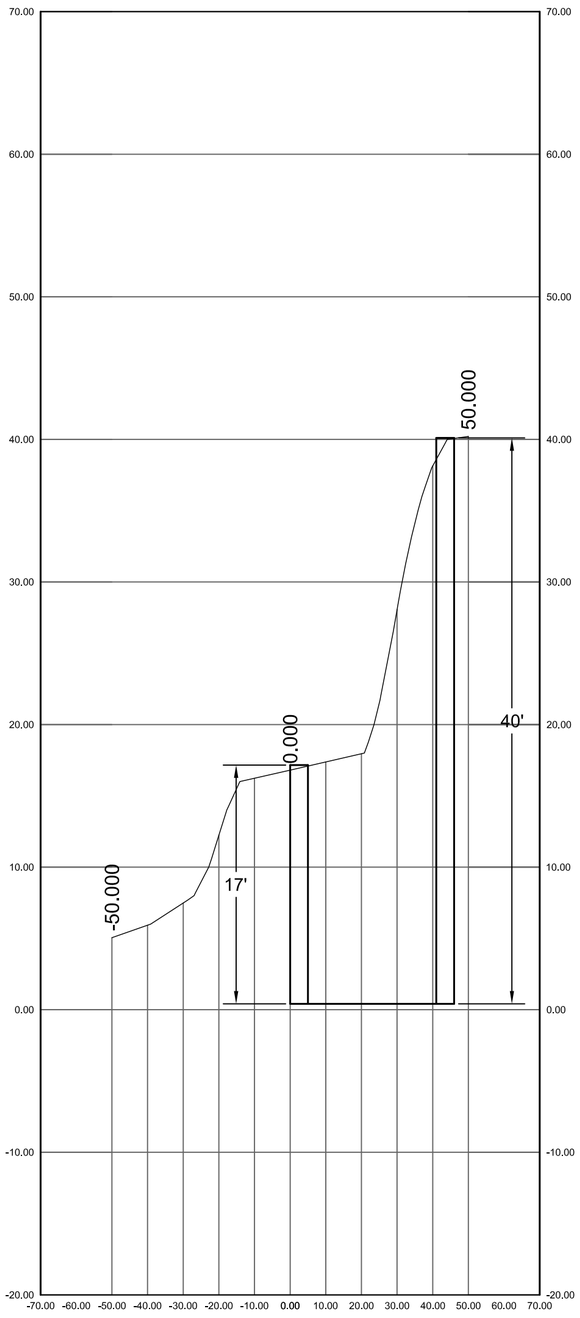

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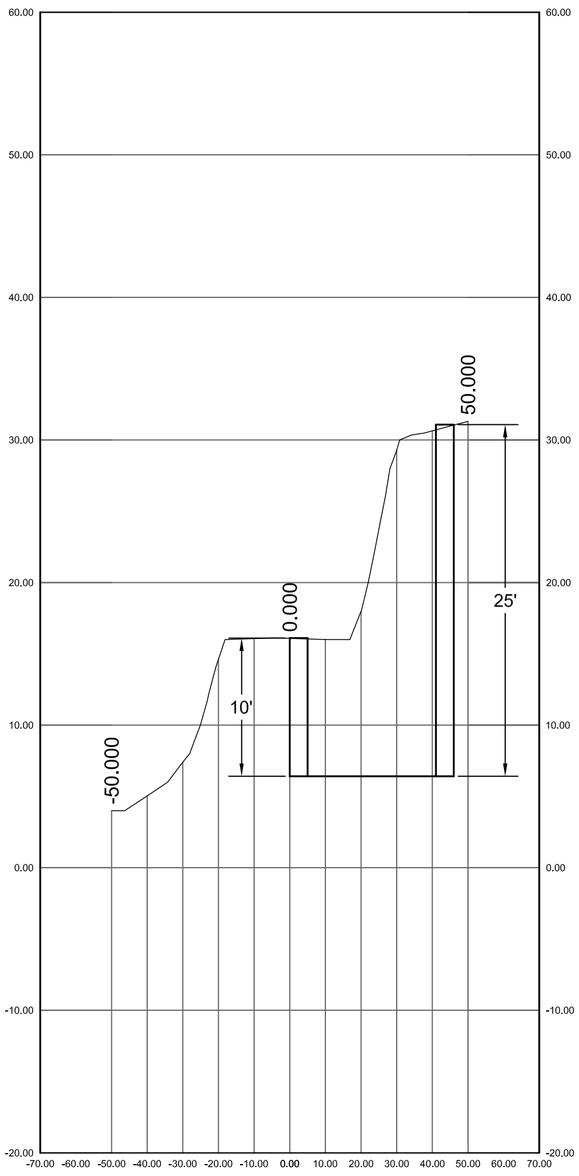

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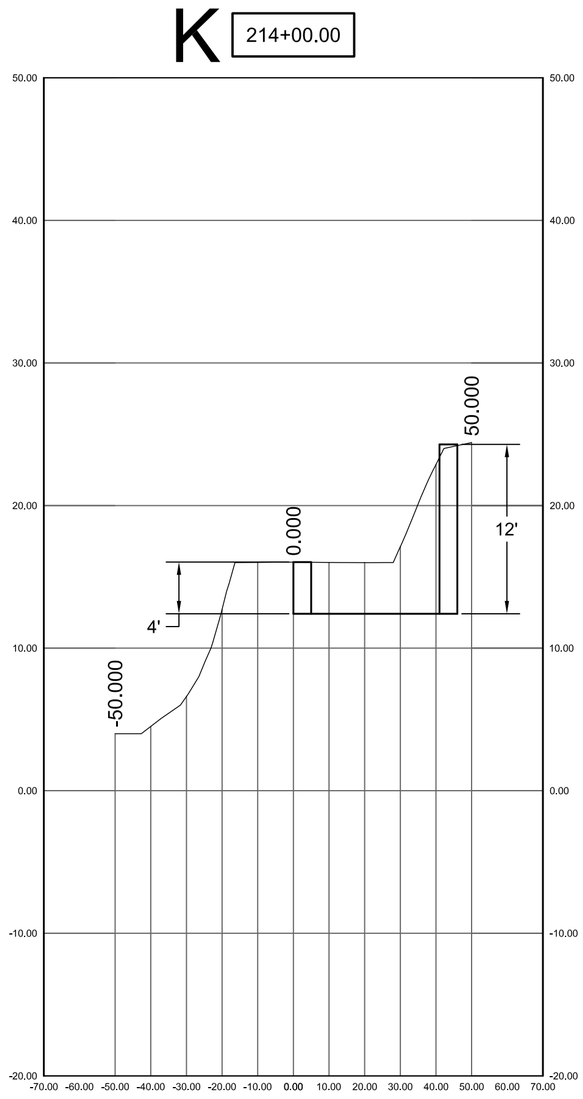

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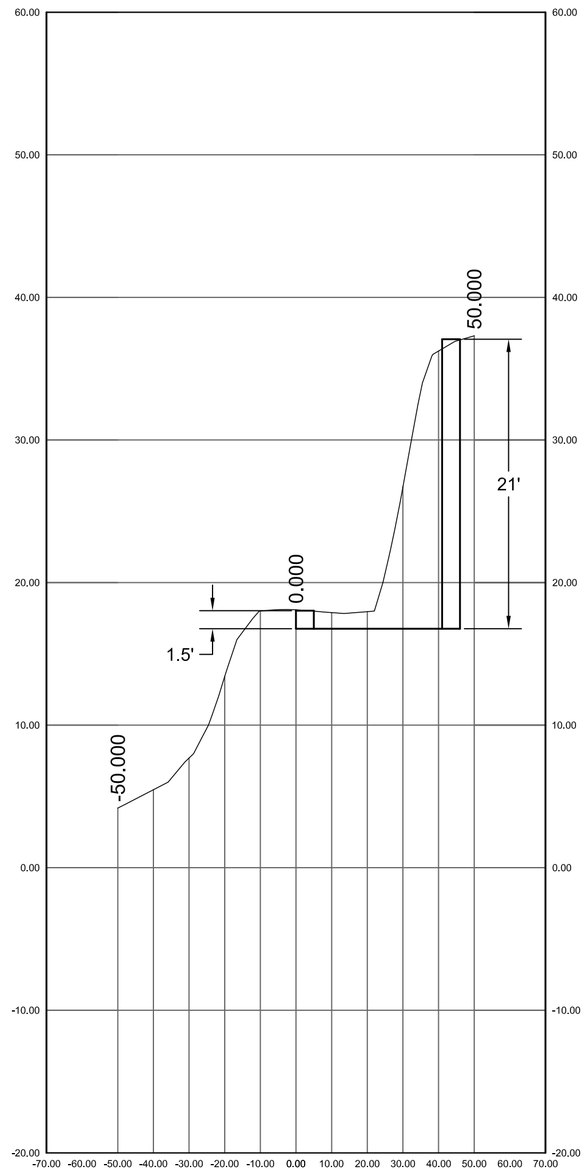

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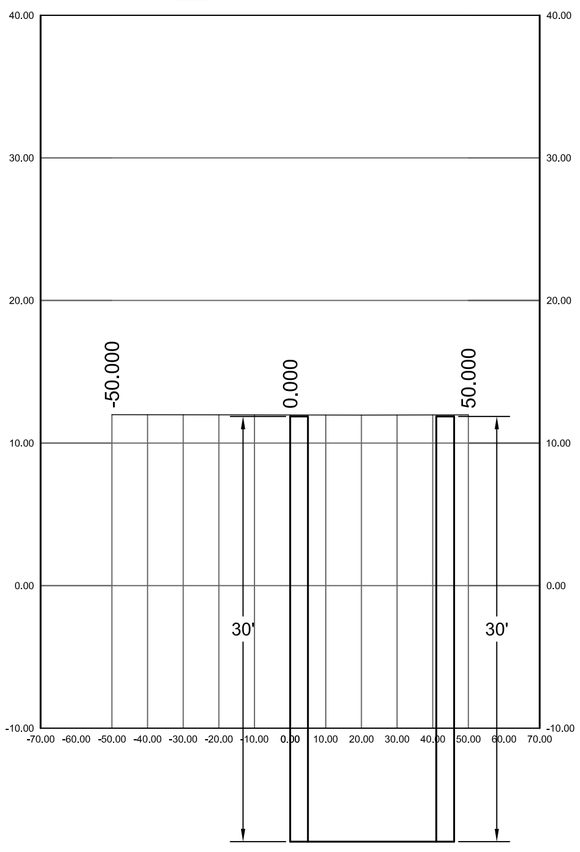

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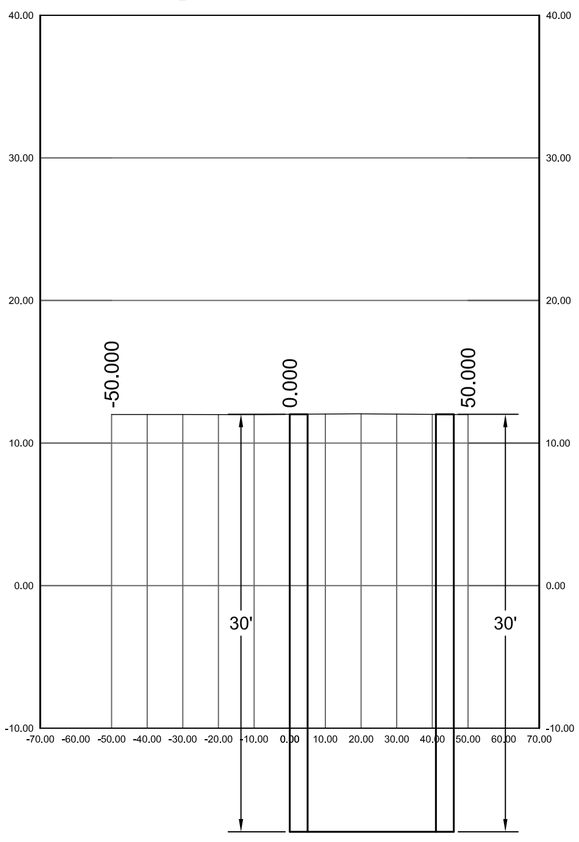

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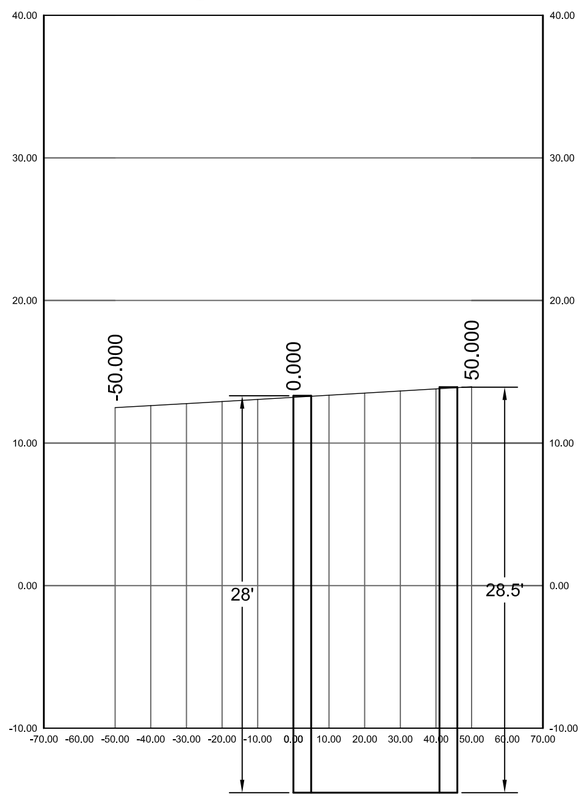

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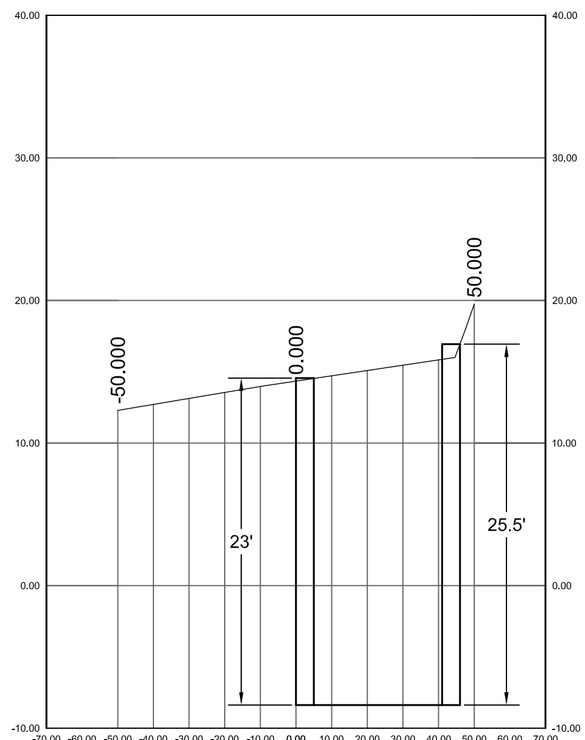

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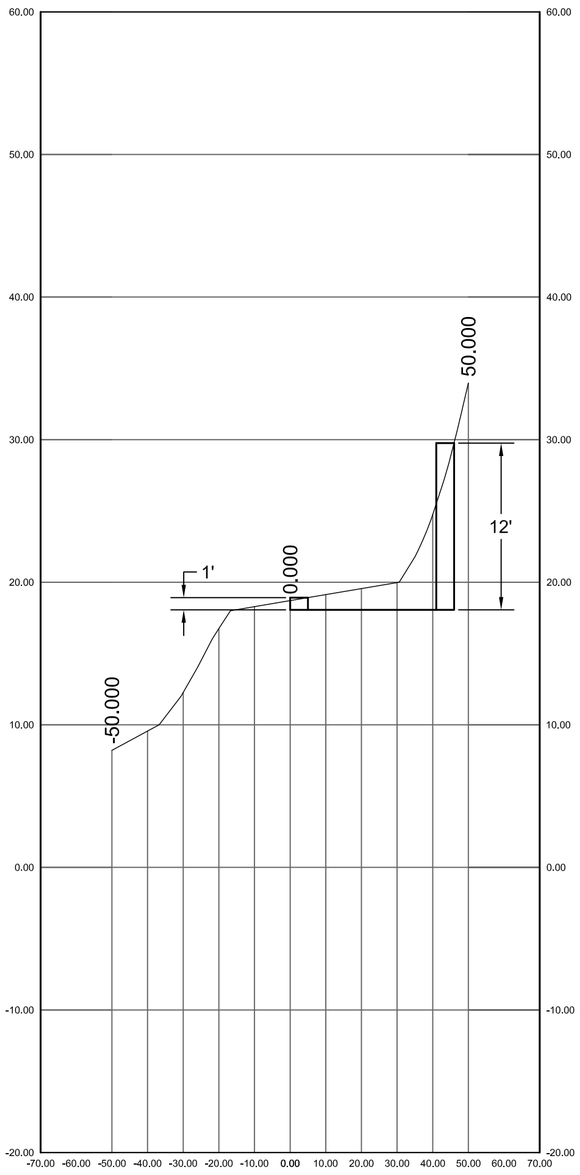

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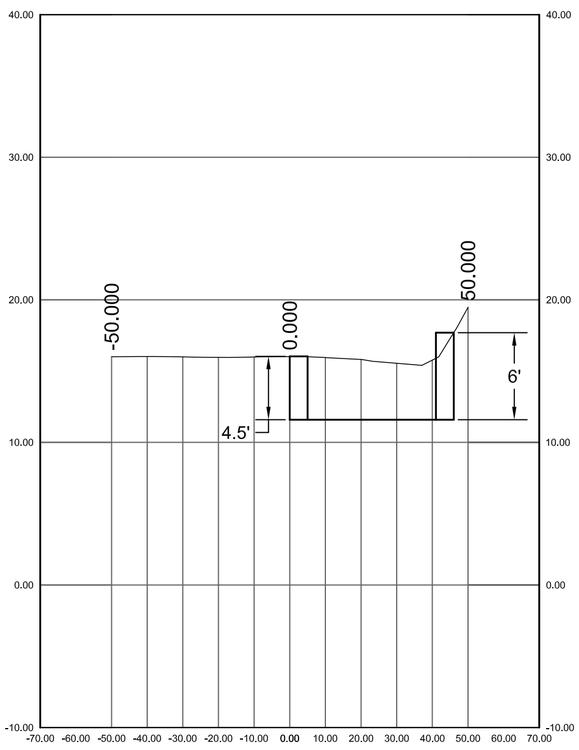

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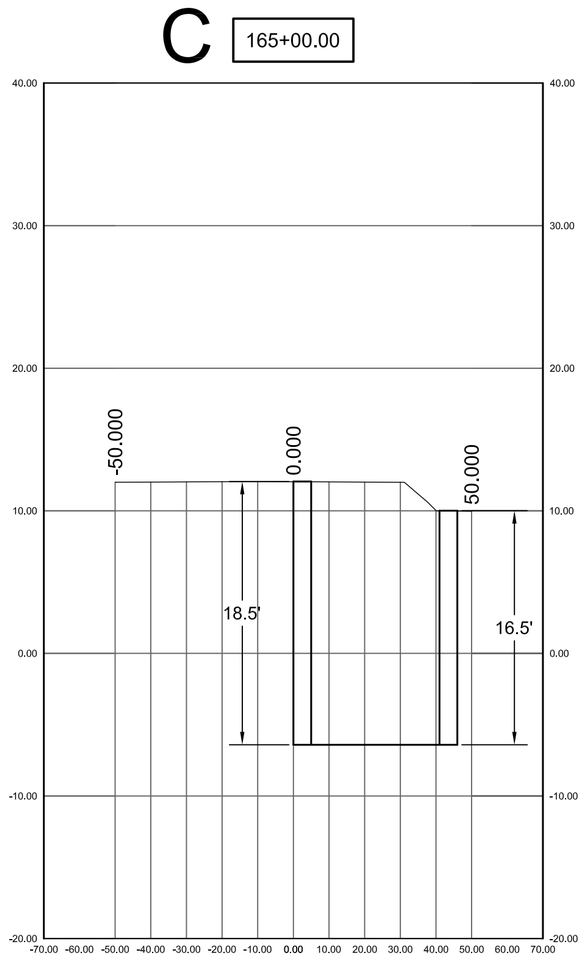

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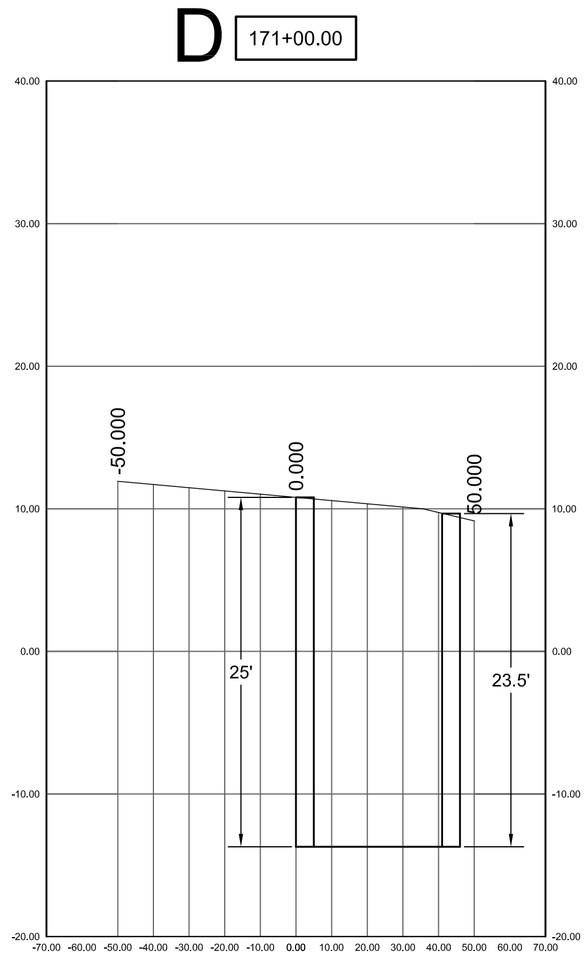

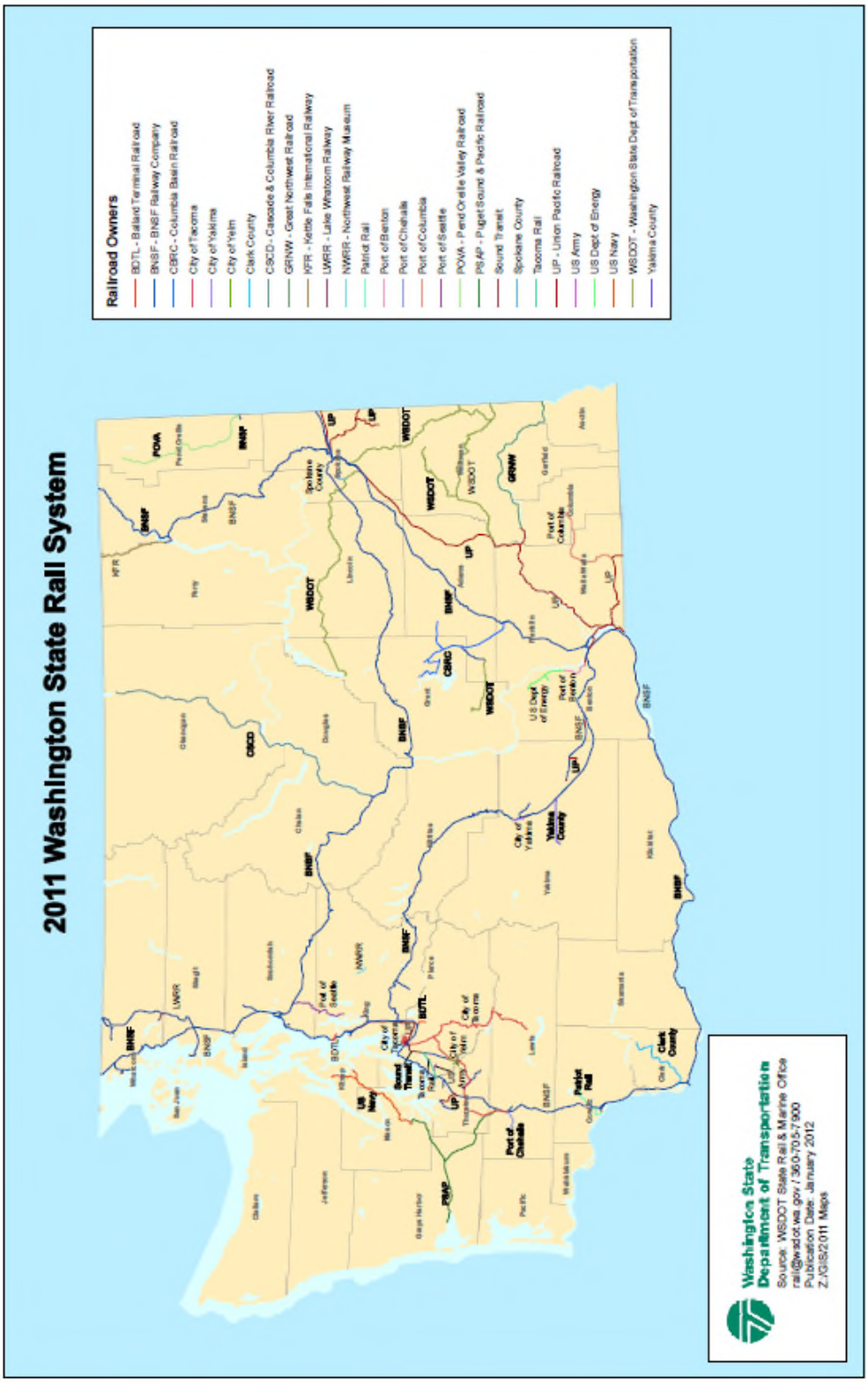

Figure 4. Rail System across Washington State

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COST ESTIMATE

Estimate Summary (Low Range)

Construction Costs		$136,403,135
Contingency	30%	$ 40,920,941
Management Reserve	10.0%	$19,416,986.27
Sales Tax	9.5%	$16,845,787.17
CN Subtotal		$194,169,863
Project Management & Administration	3%	$5,825,095.88
Engineering	12%	$23,300,383.52
Environmental Mitigation	2%	$3,883,397.25
Environmental Review and Permitting (EIS)	$5,000,000	$5,000,000.00
700 Level Items	$ -	$ -
800 Level Items	$ -	$ -
Total Project Costs		$251,595,726

Project Title	Edmonds Train Trench
PIN #	
WIN#	
SR	
Mileposts	
Project Manager (PE)	
Preparers Name	Leo Moyer
Date of Costs	10/14
Date of Update	
Date of Basis of Estimate	
Date of Review	

Summary Project Assumptions

Summary of Risks

Estimate Summary (High Range)

Construction Costs		$136,403,135
Contingency	50%	$ 68,201,568
Management Reserve	10.0%	$22,404,214.92
Sales Tax	9.5%	$19,437,446.74
CN Subtotal		$224,042,149
Project Management & Administration	3%	$6,721,264.48
Engineering	12%	$26,885,057.91
Environmental Mitigation	2%	$4,480,842.98
Environmental Review and Permitting (EIS)	$5,000,000	$5,000,000.00
700 Level Items	$ -	$ -
800 Level Items	$ -	$ -
Total Project Costs		$289,533,530

Project Title	Edmonds Train Trench
PIN #	
WIN#	
SR	
Mileposts	
Project Manager (PE)	
Preparers Name	Leo Moyer
Date of Costs	10/14
Date of Update	
Date of Basis of Estimate	
Date of Review	

Summary Project Assumptions

Summary of Risks

COST ESTIMATE
Strategic Analysis and Estimating Office

PIN NUMBER:		DESCRIPTION OF WORK
SR, MP's:		
PROJECT TITLE:		
Edmonds Train Trench		
REGION:		

Item Description	UOM	Unit Quan	Item Unit Cost	By Item Total	Major Item LS Total	Group Total	NOTES
MOBILIZATION AND PREPARATION						$ 2,000,000	
Mobilization	L.S.	1	2000000		$ 2,000,000		
					$ -		
				$ -			
				$ -			
				$ -			
GRADING, DRAINAGE AND STOCKPILING						$ 13,833,000	
Excavation Segment A	CY	5200	60		$ 312,000		Assume 30-mile round trip
Excavation Segment B	CY	6300	60		$ 378,000		
Excavation Segment C	CY	21000	60		$ 1,260,000		
Excavation Segment D	CY	24250	60		$ 1,455,000		
Excavation Segment E	CY	34000	60		$ 2,040,000		
Excavation Segment F	CY	28000	60		$ 1,680,000		
Excavation Segment G	CY	22600	60		$ 1,356,000		
Excavation Segment H	CY	19400	60		$ 1,164,000		
Excavation Segment I	CY	19000	60		$ 1,140,000		
Excavation Segment J	CY	9330	60		$ 559,800		
Excavation Segment K	CY	4270	60		$ 256,200		
Excavation Segment L	CY	9000	60		$ 540,000		
Contaminated Soil Removal	CY	16920	100		$ 1,692,000		Assume segments E, F and G contain 20% contaminated soil
					$ -		
				$ -			
				$ -			
WATERLINES, STORM AND SANITARY SEWERS						$ 2,025,000	
Shellabarger Creek Crossing	L.S.	1	1565000		$ 1,565,000		Additional stream relocation length and new rail crossing
Dayton Ave Utility Crossing	L.S.	1	50000		$ 50,000		
Main Street Utility Crossing	L.S.	1	50000		$ 50,000		
Sanitary Sewer Treatment Plant Outfall	L.S.	1	200000		$ 200,000		
Dayton Ave Storm Drain Trunk Crossing	L.S.	1	160000		$ 160,000		
					$ -		
				$ -			
STRUCTURES						$ 113,250,135	
Structural Drilled Shafts up to 15' Long	LF	3573.5	680		$ 2,429,980		Secant pile wall costs per calcs
Structural Drilled Shafts up to 16' - 30' Long	LF	5697	750		$ 4,272,750		
Structural Drilled Shafts up to 31' - 45' Long	LF	18530.5	820		$ 15,195,010		
Structural Drilled Shafts up to 46' - 60' Long	LF	32429	875		$ 28,375,375		
Structural Drilled Shafts up to 61' - 75' Long	LF	3360	930		$ 3,124,800		
Lean Concrete Shafts up to 20' Long	LF	7145.5	490		$ 3,501,295		
Lean Concrete Shafts over 20' Long	LF	30067.5	620		$ 18,641,850		
Wall Facing	SF	303525	35		$ 10,623,375		Shotcrete
Drilled Shaft Cap Beam	LF	15600	800		$ 12,480,000		
Concrete Base Slab up to 15' deep	LF	3900	930		$ 3,627,000		
Concrete Base Slab over 15' deep	LF	3900	433		$ 1,688,700		
Obstructions	L.S.	1	250000		$ 250,000		
Shaft Surveying	L.S.	1	120000		$ 120,000		
Main Street Road Crossing	SF	3750	100		$ 375,000		Bridge cost per typ. past projects
Dayton Ave Road Crossing	SF	3750	100		$ 375,000		
Re-align Railroad Siding	LF	500	500		$ 250,000		Connect existing track to siding at grade level

COST ESTIMATE
Strategic Analysis and Estimating Office

PIN NUMBER:		DESCRIPTION OF WORK
SR, MP's:		
PROJECT TITLE:		
Edmonds Train Trench		
REGION:		

Item Description	UOM	Unit Quan	Item Unit Cost	By Item Total	Major Item LS Total	Group Total	NOTES
Re-align Railroad	LF	1000	500		$ 500,000		Re-align existing double tracks to trench at each end
Construct Temporary Track	LF	4000	200		$ 800,000		
New Railroad Track	LF	15600	200		$ 3,120,000		Surface, ballast and tracks (double track)
Modify Railroad Station	LS	1	3500000		$ 3,500,000		Reconfigure parking lot, possibly move building, construct new platform with stairs and elevators
				$ -			
				$ -			
ASPHALT AND SURFACING						$ -	
					$ -		
					$ -		
				$ -			
				$ -			
CEMENT CONCRETE PAVEMENT						$ -	
					$ -		
					$ -		
				$ -			
				$ -			
				$ -			
TRAFFIC CONTROL						$ 820,000	
Railroad Flagging/Traffic Control	LS	1	720000		$ 720,000		$120K/year * 2 people * 3 years
Dayton and Main Street Traffic Control	LS	1	100000		$ 100,000		
				$ -			
				$ -			
OTHER ITEMS						$ 4,475,000	
Landscaping	LS	1	200000		$ 200,000		~$25 per foot of project length
Active Dewatering	LS	1			$ -		Consider passive drains in trench base slab
Stormwater Drainage and Treatment	LS	1	1133000		$ 1,133,000		Drainage, treatment and pump station
Real Estate Acquisition	SF	28500	150		$ 4,275,000		Quantity scaled off of map, additional real estate may be required to make room for trench while operating one rail line
				$ -			
				$ -			
NON - BID COSTS 700 Level Items						$ -	
NON - BID COSTS 800 Level Items						$ -	
					$ -		
					$ -		
				$ -			
				$ -			

Total	$ 136,403,135